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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to the hose for transportation which uses carbon dioxide as a refrigerant, and it starts the hose for transportation which prevented the penetration of the carbon dioxide as a refrigerant thoroughly, maintaining pliability.

[0002]

[Description of the Prior Art]Although chlorofluorocarbon (CFC-12) was conventionally used as a refrigerant of the air-conditioner system of a car, the use was forbidden for preservation of earth environment. And (HFC-134a) is widely used as a chlorofluorocarbon alternative. However, this chlorofluorocarbon alternative is also seen in earth environment, and although an ozone destruction coefficient is zero, a global warming coefficient is causing warming promotion highly.

[0003]For this reason, conversion to the small refrigerant of a global warming potential is studied, and that development that uses carbon dioxide as a refrigerant as one is furthered. However, by the air-conditioner system using carbon dioxide, a service condition becomes severe and differing from the air-conditioner system which used HFC-134a greatly is especially pointed out with the hose by the side of discharge. For example, the system which the resisting pressure target required with carbon dioxide to being 3 - 4Mpa in the air-conditioner system which used HFC-134a takes 150-170 \*\* to the latter to the former being 120 \*\* in heatproof 15 to 20 Mpa. The gas permeability coefficient under these conditions of carbon dioxide is about 200 times the permeability coefficient of HFC-134a, and this measure is also required for it.

[0004]When the polymer material which constitutes the hose for refrigerants from under such conditions is chosen, Even if it used thermoplastics, such as an alloy of nylon or nylon, and an olefin, for the tapetum, the transmission quantity of carbon dioxide will be about 20 times the transmission quantity in the system using the present HFC-134a, and use cannot be presented

with it in practice as an air-conditioner system. When saying, since service temperature was also very higher than HFC-134a, it was very difficult to constitute a hose only from rubber or thermoplastics.

[0005] Thus, since the hose by a polymer material cannot present practical use, the hose which carried out braid reinforcement of the metal wire is partly proposed by this using metal accordion tubes. Since this hose is a metal tube, the penetration of carbon dioxide has many points which must be improved in respect of [ of what can be prevented thoroughly ] others. That is, it remains in use in the range which the bellows of a metal accordion tube does not transform with internal pressure, if internal pressure becomes high, it is necessary to thicken thickness of bellows beforehand according to it, and weight becomes heavy and it also becomes a cost hike.

[0006] Of course, it cannot be denied that pliability will become scarce so much if the thickness of an accordion tube becomes thick, pliability is as low as the thing for high voltage, and execution workability worsens. It was repeatedly weak to crookedness, and the crack entered for a short time comparatively, and such an accordion tube was low as practical use value.

[0007]

[Problem(s) to be Solved by the Invention] This invention relates to the optimal hose, using carbon dioxide as a refrigerant.

The purpose is to provide the hose in which structure is also comparatively easy.

[0008]

[Means for Solving the Problem] It is characterized by a hose for refrigerants of this invention serving as [ outside / the ] an inner surface metal layer from a wrap reinforcement layer in the outside of a wrap elastic layer and the elastic layer concerned, and preferably, having the thickness by which an inner surface metal layer is an accordion tube, and an elastic layer buries a dent part of an accordion tube -- a reinforcement layer -- a metal wire or organic textiles -- a braid -- or a spiral volume is carried out.

[0009]

[Embodiment of the Invention] If a gestalt with a preferred hose of this invention is explained hereafter, will prevent the penetration of carbon dioxide thoroughly by equipping an innermost layer with a metal layer (accordion tube), and. Flexibility is given, an elastic layer is further formed on this metal layer, the internal pressure applied to a metal layer by this is distributed, and this layer is made to bear internal pressure uniformly by considering it as an accordion tube. Flexibility is held again by carrying out \*\*\*\*\* (ing) or the Spa Lal volume attachment of a metal wire or the organic textiles as a reinforcement layer.

[0010] Stainless steel, copper, and an aluminum alloy are mentioned as a material which forms a metal layer. Brass plating may be beforehand performed to the surface for adhesion of a

metal layer with a wrap elastic layer. Even if the bellows shape of the accordion tube which is a desirable gestalt of a metal layer is spiral, it may be the bellows in which each became independent.

[0011]As an example of a wrap elastic layer, a metal layer Ethylene propylene rubber (EPDM), Rubber or thermoplastics, such as nitril butadiene rubber (NBR), chloroprene rubber (CR), isobutylene isoprene rubber (IIR), acrylic rubber (ACM), and ethylene acrylic rubber (AEM), is independent, or is mixed, and is used. It cannot be overemphasized that the wrap elastic layer does not need to bury the dent part of an accordion tube for a metal layer thoroughly.

[0012]When using thermoplastics as an elastic layer, it is effective to heat a metal accordion tube, in order to make it filled up with resin to the dent part of an accordion tube still more easily, or to heat metal for resin by after-covering high-frequency induction heating etc.

[0013]As an example of a wrap reinforcement layer, an elastic layer A steel wire, a stainless wire, A polyethylene terephthalate fiber (PET), polyethylenenaphthalate textiles (PEN), a nylon fiber, an aramid fiber, carbon fiber, etc. can be used, and it is mutually considered as the spiral layer rolled in the braid, or a pair and the direction to make.

[0014]in addition -- responding to the purpose, although this reinforcement layer may be surrounded, an external layer can also be formed and the material same in material as the above-mentioned elastic layer may be sufficient -- the suitably optimal \*\*\*\*\* -- it becomes things. An external layer can also be removed by making a reinforcement layer into a stainless wire.

[0015]

[Example](Example of manufacture) This invention is explained still in detail with an example. First, after degreasing this outside surface enough using a with 0.2-mm7.5 mm in inside diameter in thickness, the outer diameter of 11.5 mm, and a pitch [ of bellows ] of 2 mm spiral accordion tube, two coats was given, using KEMUROKKU 205 and KEMUROKKU 234B (all are load company make) as a vulcanization adhesion agent. [ made from stainless steel ]

[0016]The mandrel equivalent to the inside diameter of the accordion tube made from iron used as an axis, etc. was inserted inside the accordion tube here. And EPDM rubber was covered as an elastic layer using the extrusion machine which has a crosshead on the periphery of the accordion tube. At this time, it extruded so that EPDM rubber might fill up the dent part of bellows thoroughly, and conditions were adjusted. Although the mandrel was inserted in the accordion tube and covered with this example with the elastic layer, also not using a mandrel, covering of an elastic layer is possible.

[0017]Subsequently, on EPDM (unvulcanized) rubber, four hard drawn steel wires with a thickness of 0.33 mm which carried out brass plating were doubled, and it knit up out of the braider of 24 carriers in the pitch of 30 mm, and was considered as the reinforcement layer. The sheet of 0.8-mm-thick EPDM was twisted around the outer layer of this reinforcement

layer as an external layer for reinforcement layer protection, and also the wrapping sheet was twisted outside.

[0018]Vulcanization of this hose was performed at 150 °C for 60 minutes, after removing a wrapping sheet, the mandrel in an accordion tube was sampled and the hose for refrigerants was obtained. Drawing 1 and drawing 2 are the partial notching side views of this hose for refrigerants. Among a figure, an elastic layer and 3 are reinforcement layers a spiral metal tube and 2, drawing 1 is a hose for refrigerants (example 1) which does not cover the external layer 4, and drawing 2 of the numerals 1 is the hose (example 2) which gave this external layer.

[0019](Example of an examination) This hose was made into a length of 500 mm, the splicing fittings used for a known metal accordion tube were attached, and it compared with the known metal accordion tube hose (comparative example 1) about pliability, pressure resistance, repetition bending performance, and the repetition application-of-pressure performance. The composition of this hose is as being shown in drawing 3, and is designed it be equal to use of 20MPa. A test result is shown in drawing 3.

[0020]Pliability: It was considered as the power at the time of bending to one 5 times the radius of an outer diameter.

Pressure resistance: Apply internal pressure with water pressure and it is a pressure at the time of being destroyed.

Repetition bending performance: The hose was attached to U type, 150 mm and the longest point were repeated as 250 mm, the shortest point was bent, and repeat frequency until internal pressure leaks from a hose was counted.

Repetition application-of-pressure performance: A 500-mm hose was attached to U type with bend radii of 75 mm, and internal pressure was repeatedly pressurized [ by making 15MPa - 0MPa into one cycle ] at 30 cpm in 150 °C atmosphere.

[0021]

[Effect of the Invention]Compared with the conventional metal accordion tube hose, pliability and pressure resistance of the hose [ for refrigerants ] in this invention improve, and also repetition bending performance and repetition application-of-pressure performance improve by leaps and bounds compared with the conventional hose, and the practicality is very high.

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[Translation done.]